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EFFECT OF CONIFER SEED PRE-STRATIFICATION FUNGICIDE TREATMENT ON MOLD DEVELOPMENT AND SEEDLING EMERGENCE AT TWO CALIFORNIA NURSERIES

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ABSTRACT

The need for a pre-stratification treatment of conifer seeds with fungicides was evaluated by comparing mold development in bags and seedling emergence after sowing of treated and nontreated seeds at Humboldt and Placerville nurseries. There were little or no differences in mold development, seedling emergence, or seedling survival among captan-treated, thiram-treated, or nontreated seeds of white fir, red fir, sugar pine or Douglas-fir. Results indicate that, with the possible exception of sugar pine, a pre-stratification fungicide treatment of seeds could be omitted from the nursery program with no adverse effects.

INTRODUCTION

Treatment of conifer seed with the fungicide captan prior to stratification has been a standard practice at the USDA Forest Service Humboldt and Placerville nurseries, and at some of the California Department of Forestry nurseries. Because captan was re-classified in 1984 as a toxicity Category I (Danger) pesticide, the efficacy of the treatment for preventing mold development in bags during naked stratification and its effect on subsequent seed germination were re-evaluated (Reference 3420 Pest Management Evaluation, Report No. 85-35, December 6, 1985).

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Results and observations of that 1985 study indicated that, compared to no fungicide treatment, captan (Captan 50-W)-treated and thiram (42-S)-treated seeds of seven conifer species had less mold development in bags during stratification. Based on those results, a Special Local Need (CA 860014) for the use of Captan 50-W on conifer seed during stratification was obtained. However, the study also indicated that mold fungi that grew on nontreated seed had no apparent effect on germination. A recommendation was made that, before nurseries consider omitting a pre-stratification fungicide dip treatment, the procedure should be tested on a production basis and that information on any adverse effects of molds on seedlings after sowing be obtained. This 1986 evaluation reports results of the recommended studies carried out by Placerville and Humboldt nurseries.

The study objectives were to determine the need for a pre-stratification treatment of conifer seeds with fungicides by comparing mold development in bags and seedling emergence after sowing of treated and nontreated seeds.

PROCEDURES

Placerville Nursery

Three seedlots of three species (sugar pine, white fir, and red fir) were selected in the spring of 1986. Each lot was divided into three sub-lots (treatments), and each sub-lot further divided into three bags (replicates). After a 48-hour soak in water, each sub-lot (consisting of 3 bags) received one of the following treatments: 1) no dip (control); 2) dip in a solution containing 1 oz (dry measure) of captan; 3) dip in a solution containing 1 fluid oz of thiram/gal of water. After stratification (45 days for white fir and red fir; 90 days for sugar pine), each bag was examined and qualitative notes on mold development (none, light, heavy), were recorded.

Seeds were sown in beds in a split-plot design, with lots as the main plots and 1) no dip (control), 2) captan-treated, and 3) thiram-treated seeds as the sub-plots. Plots and sub-plots were randomized in each of three replicates, with the replicates placed continuously down one bed.

During the standard June, 1986 inventory where bed densities are determined, counts of live and dead seedlings in each sub-plot were taken and recorded for data analysis.

Humboldt Nursery

One lot of Douglas-fir seed was divided into two sub-lots and each sub-lot further divided into two bags (approximately 6.8 lbs of seed) in March, 1986. After a 48-hour soak in water, two of the four bags were dipped in captan, and two received no treatment. Following stratification for 71 days, the bags were examined for mold development. Captan-treated seeds were sown in different beds from non-treated seed, but the two replicate bags were not kept separate. The seedlot was inventoried in June, 1986 and the number of seedlings per square foot in each of the two treatments was determined.

RESULTS

Placerville Nursery

There were no visual differences in mold development in bags containing fungicide-treated or nontreated seeds with any of the three species.

For both white fir and red fir, significant F values were not found for seedlot effects, treatment effects, or for seedlot-treatment interaction (Table 1). Regardless of seedlot, treatment had no significant effect on percentage of dead seedlings in beds.

For sugar pine, a significant F value was found for seedlot effects, but not for treatment effects or for seedlot-treatment interactions (Table 1). Differences among seedlots were significant, but there were no significant differences in percentages of seedlings dead in each of the three treatments within a seedlot. Although not significant, percentage of seedlings dead were higher with nontreated seed than with fungicide-treated seed in seedlots 1 and 2. When data for each species were averaged, no significant differences were found.

Table 1. Percentage of seedlings dead for three conifer species at Placerville Nursery as affected by seedlot and pre-stratification fungicide treatment.

Species	Lot	Treatment[x]		
		Control	Captan	Thiram
White fir	1	2.2 [y]	2.0	3.0
	2	2.1	2.3	2.6
	3	1.8	2.4	2.5
	Average	2.0	2.2	2.7
Red fir	1	2.8	3.7	3.9
	2	3.3	3.2	2.1
	3	-	-	-
	Average	3.0	3.5	3.0
Sugar pine	1	31.6 a[z]	23.7	25.9
	2	23.8 b	19.4	23.3
	3	10.7 c	13.6	13.8
	Average	22.0	18.9	21.0

[x] Control = no treatment
Captan = dipped in Captan 50-W (1 oz/gal water)
Thiram = dipped in 42-S (1 oz/gal water)

[y] Average percentage of seedlings dead in three replicate plots. Based on counts of live and dead seedlings in 10, 0.5 ft X 4 ft plots, for each replicate.

[z] Means followed by a common letter are not significantly different (P=0.05) according to Duncan's multiple range test.

Humboldt Nursery

No mold development was observed in any of the bags. Statistical analysis of bed counts of seedlings was not possible because replicates were not recorded separately. However, only slight differences among average number of Douglas-fir seedlings per square foot were recorded for captan-treated vs. nontreated seeds (15.5 vs. 13.3). These data suggest that treatment of seed resulted in about two additional seedlings per square foot of bed than nontreatment.

CONCLUSIONS AND RECOMMENDATION

The data obtained in this 1986 evaluation, along with previous data in 1985, indicate that, with the possible exception of sugar pine, a pre-stratification treatment of conifer seed with fungicides to prevent mold development is not necessary. The 1985 evaluation indicated that captan-treated and thiram-treated seeds were visually cleaner of molds than untreated seeds, but the molds that did develop on untreated seeds had no apparent effect on germination. This subsequent evaluation at Humboldt and Placerville nurseries indicates little or no differences in seedling emergence or survival among captan-treated, thiram-treated, or nontreated seeds.

Although differences were not significant, there were more dead seedlings with nontreated than with fungicide-treated seed in two of the three lots of sugar pine. Differences may have been due to factors other than the pre-stratification treatment. For example, levels of Fusarium hypocotyl rot in beds may have varied.

Species of Fusarium were not found on sugar pine seed in the 1985 study. However, literature does suggest that Fusarium spp. may be external contaminants on sugar pine seed. Some Fusarium spp. could spread to other seed in bags during stratification and then either reduce germination or infect seeds during germination and cause damping-off of the sown seed. A pre-stratification treatment with captan may reduce the risk of Fusarium spp. spreading among seeds during the long stratification period required for sugar pine.

Nurseries have several alternatives for handling sugar pine seed during stratification. They could continue to routinely treat all sugar pine seedlots with captan. This may decrease any risk of loss from Fusarium molds adding to other losses suffered by the species after sowing. A second alternative is to sample each seedlot prior to stratification for the presence of Fusarium spp., and then treat only those seedlots where the fungus was found. A third alternative would be to handle sugar pine as other conifers and not treat any of the seedlots with a fungicide. Losses from molds would normally be very low, but could occur sporadically. If this alternative is choosen, the procedures discussed below should be followed.

If pre-stratification fungicide treatment is omitted from nursery practice, other procedures in the stratification process need to be done correctly or added to reduce the risk of problems from mold fungi. Some of these are:

1. Wash the seeds during the 24-to 48-hour water soak by changing the water several times or, better, by having a continous flow of water. This would remove many of the fungal spores from seed coat surfaces. Cleaner seeds such as the pines would need less washing than more contaminated seeds like true fir and incense-cedar.

2. Temperatures in coolers need to be kept as close to 32 F as possible during stratification to reduce mold development. This would be especially important for species such as sugar pine that require a long stratification time period. One reason for initiating treatment with fungicides at Humboldt and Placerville nurseries was poor control of temperatures during stratification (Jenkinson, personal communication).

3. Reducing moisture in bags during stratification by decreasing the surface moisture content of the seeds after soaking and increasing aeration in the bags would leave a less favorable environment for growth of surface contaminant fungi. Draining the bags for a longer period of time before placing them in coolers may be helpful. Using smaller amounts of seeds in each bag would probably reduce free water and increase aeration. Smaller quantities of seed may also provide for more uniform and cooler temperatures in the bags.

Because adoption of no pre-stratification fungicide treatment would be a new nursery practice, the procedure should be monitored over several years in order to build an information base. Bags removed from stratification should be recorded as to degree of mold development. Seedlots which appear to have excessive mold development should be followed after sowing through standard inventory counts in order to determine if molds may have affected field performance.